CURRICULUM VITAE

Konstantin Nikolayevich Lipnikov

Personal Information:

Date of Birth:	July 8, 1967.
Birthplace:	Yaroslavl, USSR
Citizenship:	Russian
Marital Status:	Bachelor
Home Address:	3200 Canyon Rd. Apt. 4104 Los Alamos, NM 87544
Work Address:	MS B284 Los Alamos National Laboratory Los Alamos, NM 87545 Phone: (505)-667-1719 E-mail: `lipnikov@lanl.gov`
Present Position:	Limited Term Staff Member Mathematical Modeling and Analysis Group Theoretical Division Los Alamos National Laboratory Los Alamos, NM 87545

Revised: February 2006

Education:

Ph.D.	Mathematics, University of Houston, May 2002 Thesis: *Numerical Methods for the Biot Model in Poroelasticity* Adviser: *Yuri A. Kuznetsov*
M.S.	Mathematics, University of Houston, Fall 2000, GPA 3.94/4.00
M.S.	Applied Mathematics, Moscow Institute of Physics and Technology, 1990, Moscow Region, RUSSIA

Employment History:

01/2005 – *present*	*Limited Term Staff Member* Mathematical Modeling and Analysis Group, Theoretical Division Los Alamos National Laboratory, Los Alamos, NM
06/2002 – 12/2004	*Postdoctoral Research Associate* Mathematical Modeling and Analysis Group, Theoretical Division Los Alamos National Laboratory, Los Alamos, NM
09/2001 – 05/2002	*Research Assistant* Department of Mathematics, University of Houston, Houston, TX
06/2001 – 08/2001	*Graduate Research Assistant* Mathematical Modeling and Analysis Group, Theoretical Division Los Alamos National Laboratory, Los Alamos, NM
09/2000 – 05/2001	*Research Assistant* Department of Mathematics, University of Houston, Houston, TX
06/2000 – 07/2000	*Graduate Research Assistant* Computational Fluid Dynamics Laboratory, University of Texas, Austin, TX
01/1999 – 05/2000	*Research Assistant/Teaching Assistant* Department of Mathematics, University of Houston, Houston, TX
09/1993 – 01/1999	*Staff Member* Institute of Numerical Mathematics, Moscow, RUSSIA
09/1990 – 07/1993	*Researcher Assistant* Moscow Institute of Physics and Technology, Moscow, RUSSIA

Research Experience:

2002 – *present* — *Post Doc/Staff Member*, Mathematical Modeling and Analysis Group, Los Alamos National Laboratory. I have developed new mimetic finite difference discretization methods that are effective for diffusion problems with highly discontinuous coefficients on severely distorted polyhedral grids. Recently, this research has been applied in artificially viscosity methods for gasdynamics and has generated an interest in developing similar mimetic discretizations for problems in seismology (analysis of elastic waves scattering in heterogeneous media) and in fluid flows (analysis of transport of pollutant from streams and rivers into underground water reservoirs). I'm also continuing to develop robust moving mesh methods for gasdynamics that capture the solution dynamics and therefore increase accuracy of computer simulations.

1999 – 2001 — *Ph.D. research*, Department of Mathematics, University of Houston. I conducted research on numerical methods for solving the system of partial differential equations describing two basic mechanical processes in porous media: single-phase fluid flow and rock deformation. The research was supported in part by a few grants from the Exxon-Mobil Upstream Research Company.

2001 (Summer) — *Visitor/Graduate Research Assistant*, Mathematical Modeling and Analysis Group, Los Alamos National Laboratory. During my Ph.D. studies, I began collaboration on analysis of key aspects of the support operator methods that were developed at LANL and were used in several codes. In particular, I gave the first proof of convergence of these methods. It marked the beginning of an exciting new approach to creating new discretization methods.

2000 (Summer) — *Visitor/Graduate Research Assistant*, Computational Fluid Dynamics Laboratory, University of Texas, Austin, TX. I collaborated with Prof. Graham Carey on extending the cascadic multigrid methods for solving a nonlinear problem coupling flow of a viscous incompressible fluid with heat transfer and chemical species transport.

1993 – 1999 — *Staff Member*, Institute of Numerical Mathematics, Moscow, Russia. I worked on developing memory-saving numerical methods for the problem of scattering acoustic waves by an impenetrable obstacle. The developed method were used by our colleagues to solve 100 times large problems that it was possible with the other methods.

1998 (Fall) — *Visiting Researcher*, Konrad-Zuse-Zentrum Berlin, Berlin, Germany. I analyzed the cascadic multigrid method for elliptic problems with strong material discontinuities and proved its convergence for mortar finite element discretizations.

1998 (Summer) *Visiting Researcher*, Scientific Center, Dassualt-Aviation, Paris, France. I investigated a practical model for thin dielectric layers over an ideal conductor. Different properties of the dielectric were exploited via numerical experiments to characterize their impact on the far-field pattern of a scattered time-harmonic electromagnetic wave.

1996 (Spring) *Visiting Researcher*, Seoul National University, Seoul, South Korea. I analyzed an inverse acoustic problem of recovering the shape of an obstacle from the scattered wave pattern. It was shown that the regularized inverse problem allows reasonable obstacle reconstruction even in the presence of random noise in the input data.

1995 (Spring) *Visiting Researcher*, University of Neimegen, Neimegen, The Netherlands. Using the Cray Y-MP C98 supercomputer system, I studied efficient implementation of the fictitious domain method and the domain decomposition method for solving the exterior boundary value problem for the Helmholtz wave equation.

1994 (Summer) *Visiting Researcher*, University of Paris VI, Paris, France. I designed and conducted numerical experiments to study the scattering of acoustic waves by model obstacles resembling aircrafts. The success of this research was crucial for expanding the cooperation program with french colleagues.

Publications and Selected Reports (1996-2006):

Invited:

1. A node reconnection algorithm for mimetic finite difference discretizations of elliptic equations on triangular meshes, *Communications in Mathematical Sciences*, **3**:4 (2005), 665–680.

2. The Error-Minimization-based strategy for moving mesh methods. *Communications in Computational Physics*, **1**:1 (2006), 53–81.

3. Hessian based anisotropic mesh adaptation in domains with discrete boundaries, *Russian J. Numer. Analysis Math. Modelling*, **20**, No.4 (2005), 391–402.

4. On control of adaptation in parallel mesh generation, *Engineering with Computers*, **20** (2004), 193–201.

Peer-Reviewed:

5. Convergence of mimetic finite difference method for diffusion problems on polyhedral meshes with curved faces, *M3AS: Mathematical Models and Methods in Applied Sciences*, **16**:2 (2006), 275–297.

6. Convergence of mimetic finite difference method for diffusion problems on polyhedral meshes, *SIAM J. Numer. Anal.* **43**:5 (2005), 1872–1896.

7. The error-minimization-based rezone strategy for arbitrary Lagrangian-Eulerian methods, *Numerical Methods for PDEs* (2006), to appear.

8. The mimetic finite difference discretization of diffusion problem on unstructured polyhedral meshes, *J. Comp. Phys.* **211** (2006), 473–491.

9. Error bounds for controllable adaptive algorithms based on a Hessian recovery, *Computational Mathematics and Mathematical Physics*, **45**:8 (2005), 1424–1434.

10. A family of mimetic finite difference methods on polygonal and polyhedral meshes, *M3AS: Mathematical Models and Methods in Applied Sciences* **15**:10 (2005), 1533–1552.

11. A mortar mimetic finite difference method on non-matching grids, *Numer. Math.*, **102**, No.2 (2005), 203–230.

12. Superconvergence of the velocity in mimetic finite difference methods on quadrilaterals, *SIAM J. Numer. Anal.* **43**, No. 4 (2005), 1728–1749.

13. Mimetic finite difference method on polygonal meshes for diffusion-type problems, *Comp. Geosciences*, **8** (2004), 301–324.

14. Mimetic finite difference methods for diffusion equations on non-orthogonal non-conformal meshes. *J. Comp. Phys.*, **199** (2004), 589–597.

15. Mathematics modeling and numerical algorithms for poroelastic problems, *Contemporary Mathematics*, **329** (2003), 191–202.

16. Optimal triangulations: existence, approximation and double differentiation of P_1 finite element functions, *Computational Mathematics and Mathematical Physics*, **43**:6 (2003), 827–835.

17. Nested grid iteration for incompressible viscous flow and transport, *Inter. J. Comp. Fluid Dynamics*, **17**:4 (2003), 253–262.

18. Parallel adaptive solution of 3D boundary value problems by Hessian recovery, *Comput. Methods Appl. Mech. Engrg.*, **192** (2003), 1495–1513.

19. A subspace cascadic multigrid method for mortar elements, *Computing*, **69**:3 (2002), 205–225.

20. Fast separable solver for mixed finite element methods and applications, *J. Numer. Math.*, **10**:2 (2002), 137–155.

21. Convergence of mimetic finite difference discretizations of the diffusion equation, *East-West J. Numer. Math.*, **9**:4 (2001), 265–284.

22. An efficient iterative solver for a simplified poroelasticity problem, *East-West Journal*, **8**:3 (2000), 207–222.

23. Adaptive generation of quasi-optimal tetrahedral meshes, *East-West Journal*, **7** (1999), 223–244.

24. An adaptive algorithm for quasi-optimal mesh generation, *Computational Mathematics and Mathematical Physics*, **39** (1999), 1468–1486.

25. Fictitious domain methods for the numerical solution of three-dimensional acoustic scattering problems, *J. Comp. Acoustics*, **7**:3 (1998), 161–183.

26. 3D Helmholtz wave equation by fictitious domain method, *Russian J. Numer. Anal. and Math. Modelling*, **13** (1998), 371–389.

27. Domain decomposition with subdomain CCG for material jump elliptic problems, *East-West Journal*, **6** (1998), 81–100.

Under Review:

28. Local flux mimetic finite difference methods, submitted to *Mathematics of Computations*.

Proceedings:

29. On discrete boundaries and solution accuracy in anisotropic adaptive meshing, Proceedings of *14th International Meshing Roundtable*, September 11-14, 2005, San Diego, CA. Byron W.Hanks (Editor), Springer, pp.313–324.

30. Error estimates for Hessian-based mesh adaptation algorithms with control of adaptivity, Proceedings of *13th International Meshing Roundtable*, September 19-22, 2004, Williamsburg, Virginia, pp.345-351.

31. On a parallel algorithm for controlled Hessian-based mesh adaptation, Proceedings of *3rd Conf. Appl. Geometry, Mesh Generation and High Performance Computing*, Moscow, June 28 – July 1, 2004, Comp. Center RAS, Vol.1, pp.154-166.

32. Moving grids for hyperbolic problems, *Proceedings of the Workshop on Mesh Quality and Dynamic Meshing*, January 16-17, 2003, Sandia National Laboratory, Livermore, CA.

33. Fictitious domain based solvers for particulate flows, *Proceedings of the 13th International Conference on DD Methods*, October 2000, Lyon, France, pp.351–357.

34. Finite element methods with nonmatching grids and applications, *Proceedings of the Conference on Applied Mathematics and Computer Science*, October 28-29, 1996, Moscow, French-Russian A.M.Liapunov Institute, Moscow State University, pp.65–81.

Technical Reports:

35. Moving meshes for the Burgers equation, Los Alamos Report LAUR-03-7605 (2003).

36. On the application of fictitious domain and domain decomposition methods for scattering problems on Cray Y-MP C98, *Report No.9557*, University of Nijmegen, The Netherlands, 1998.

37. On using parallel MIMD computer systems in the inverse problem of acoustic scattering, *RIM–GARC Preprint Series 96-27*, Seoul National University, Seoul, South Korea, June 1996.

Scientific Presentations (2003-2006):

Invited:

1. *The error-minimization-based rezone strategy for arbitrary Lagrangian-Eulerian methods*, Seminar "Applied and Computational Mathematics", Tulane University, LA, January 2005.

2. *Mimetic finite difference methods on unstructured polyhedral meshes*, 8th US National Congress for Computational Mechanics, Austin, TX, July 2005.

Conferences:

3. *New discretization methodology for diffusion problems on generalized polyhedral meshes*, LACSI Symposium, Santa Fe, NM, October 2005.

4. *On discrete boundaries and solution accuracy in anisotropic adaptive meshing*, 14th international Meshing Roundtable, San Diego, CA, September 2005.

5. *A family of mimetic finite difference methods on polygonal and polyhedral meshes*, SIAM Annual Meeting, New Orleans, LA, July 2005.

6. *Convergence of mimetic finite difference method for diffusion problems on polyhedral meshes*, SIAM Conf. on Computational Science & Engineering, Orlando, FL, February 2005.

7. *Convergence of mimetic finite difference method for diffusion problems on polyhedral meshes*, LACSI Symposium, Santa Fe, NM, October 2004.

8. *Error estimates for Hessian-based mesh adaptation algorithms with control of adaptivity*, 13th International Meshing Roundtable, Williamsburg, VA, September 2004.

9. *The EMB rezone strategy for ALE methods*, SIAM annual meeting, Portland, OR, July 2004.

10. *Error-Minimization-Based rezone strategy for ALE methods*, 8th Copper Mountain Conference, Copper Mountain, CO, April 2004.

11. *Mimetic discretizations for diffusion equation on polygonal meshes in Cartesian and Cylindrical geometries*, LACSI Symposium, Santa Fe, NM, October 2003.

12. *Moving grids for problems of gas dynamics*, 7th US National Congress on Computational Mechanics, Albuquerque, July 2003.

13. *Robust parallel algorithm for anisotropic adaptive tetrahedral meshes*, 7th US National Congress on Computational Mechanics, Albuquerque, July 2003.

14. *Convergence of mimetic finite difference discretizations for diffusion equations*, Workshop on Mimetic Discretizations of Continuum Mechanics, San Diego, July 2003.

15. *Mimetic finite difference methods for diffusion equations on non-orthogonal AMR meshes*, Workshop on Mimetic Discretizations of Continuum Mechanics, San Diego, July 2003.

16. *Algebraic multilevel preconditioner with projectors*, 11th Copper Mountain Conference, Copper Mountain, CO, April 2003.

17. *Mimetic finite difference methods for diffusion equations on AMR meshes*, SIAM Conference on Mathematical and Computational Issues in the Geosciences, March 2003.

Workshop Organization:

1. **Organizer:** *Moving Mesh Methods*, Minisymposium at the SIAM Annual Meeting, Portland, OR, July 12-16, 2004.

2. **Co-organizer:** *Adaptive anisotropic mesh generation: Advances in analysis and practice*, Minisymposium at the SIAM Conference on Mathematical and Computational Issues in the Geosciences, Avinion, France, June 7-10, 2005.

Grant Panels:

1. *Committee Member:* Los Alamos National Laboratory, Laboratory-Directed Research and Development, Exploratory Research (LDRD/ER), *Mathematics and Computer Sciences*, 2006.

Journal Referee (2004-2006):

- Journal of Computational Physics
- SIAM Journal on Numerical Analysis
- Numerical Methods for PDEs
- Communications in Computational Physics
- Transport in Porous Media
- Applied Numerical Mathematics

Achievements and Awards:

01/2006	Achievement Award, Los Alamos National Laboratory *Outstanding contributions to the programmatic project.*
01/2006	Bibliographic reference in the 60th edition of *Who's Who in America*

Academic Activities:

1. mentor of the summer student, Daniil Svyatskiy, 2005
2. mentor of the future summer student, Danail Vassilev, 2006
3. mentor of the future postdoctoral researcher, Daniil Svyatskiy, 2006

Professional Memberships:

- Society of Industrial and Applied Mathematics
- American Mathematical Society

Computing Experience:

- *Numerical Analysis:*
  I have 15 years experience in programming algorithms for the numerical solution of partial differential equations. Knowledge of discretization techniques includes finite differences, finite elements, spectral elements, finite volume methods, etc. Knowledge of iterative solution techniques includes preconditioned Krylov subspace and multigrid methods.

- *Programming:*
  Experience with many languages, including Fortran 90/95, Fortran 77, C, C++, MPI, Matlab, Maple, LaTeX, PostScript, HTML, XML. Currently working on two multi-developer projects using concurrent versions system (CVS).